Remarks/Arguments

Claims 1-3, 8-12, 14, 17-22, 33-35 and 39-44 of the application were rejected and remain for consideration by the Examiner. Claims 23-32 and 36-38 were objected to and would be allowable if rewritten in independent form including all the limitations of the base claim and any intervening claims. Claims 4-6, 13, 15, 16, and 33-35 were previously withdrawn from consideration by the Examiner as drawn to nonelected species. The Examiner previously agreed with Applicants' previous arguments that claim 1 is generic with respect to claims 1-42 and claim 39 is generic with respect to claims 40-42.

First, claims 23-32 and 36-38 are amended herein in order to rewrite them to include all the limitations of any base claim and intervening claims, based on the then-current base and intervening claims at the time the objection was made. Specifically, to do this claim 23 is amended to include the limitations of then-current claim 1 (amended by Amendment dated April 25, 2003) and original claim 12.

Several amendments are requested to be entered that address comments made by the Examiner in his *Response to Arguments* section of the subject Official Action. It is respectfully submitted that these amendments will either place the application in condition for allowance or in better form for consideration on appeal, and should be entered in accordance with 37 CFR § 1.116. It is the Applicants' position that no amendments should be necessary for the claims to be allowed, but such amendments are proposed to be responsive to the Examiner's comments. The amendments were discussed in principle with the Examiner in a phone call on October 6, 2005, without resolution at that time.

In the Examiner's *Response to Arguments*, he stated that "the amended/original claims [1 and 43] do not claim the boiling enhancement structure being a porous component that provides re-entrant cavities." Claims 1 and 43 are amended herein merely to include the definition of a boiling enhancement structure. As stated in the Applicants' reply to the previous Official Action (Amendment dated June 21, 2005, page 15), the definition of the boiling enhancement structure comes from the specification, from which support for this Amendment is provided: The boiling enhancement structure of the Applicants' invention is "a porous component that provides re-entrant cavities" (Application p. 10, lines 20-21).

The other Amendments are directed to the Examiner's comments regarding the Andres et al. reference. The Examiner noted that "Andres states that 'the heat exchanger is independent of gravitational and inertia forces. It is assured thereby that condensate will always collect within the area of the heat supply by the heating rod, the heating channel or the like and is evaporated by the heat source.'" The Examiner considered this to mean that the Andres device is orientation-independent. The Applicant respectfully disagrees; while Andres makes such a statement, it is not true that the Andres device is orientation independent. For example, given the dish-shaped geometry of the device, with the device upside down, the device would not work, as the fluid would not be present in the evaporator, or very little of it would be present. **Nonetheless, to address the Examiner's comments, the Applicants propose amendments that specify the symmetrical design of the evaporator and condenser about a central plane, which neither Andres nor any of the other references cited by the Examiner have.** Support for such a symmetrical design is found where the specification states, for example, "The central evaporator and peripheral condenser are symmetric about a central plane, leading to independence of orien-

tation of the thermosyphon heat spreader." (Application page 5, lines 24-26). The figures and the specification also support the requirement that the condenser extend farther away from the central plane than the evaporator: "As shown in FIG. 3, the pool belt 30 has a greater height, H_B, than that of the evaporator, H_E." (Application p. 12, lines 13-14) That the evaporator and condenser have internal walls is supported by the figures and the specification. (Application p. 9, lines 8-9) Given the thorough nature of the Examiner's prior searches in both the current and the parent applications, which searches would not exclude a symmetrical design, no additional searching would be required to evaluate this proposed Amendment.

It is respectfully submitted that none of the references, individually or in combination, disclose or suggest a thermosyphon having the claimed structure and independence from orientation.

Claim Rejections – 35 USC § 103 – Andres et al. in view of Ghoshal

The Examiner rejected claims 1- 3, 12, 17-22 and 39-44 under 35 U.S.C. 103(a) as being obvious with respect to Andres et al., US Patent No. 4,550,774 (Andres) in view of Ghoshal, US Patent No. 6,474,074 (Ghoshal). These claims are nonobvious in that there is no *prima facie* case of obviousness.

1. **Claims 1-3, 17-22, and 39-42.**

The Examiner stated that Andres discloses Applicants' invention as claimed with the exception of a boiling enhancement structure that is provided by Ghoshal.

Referring to claim 1 (and 43, although the Examiner did not refer to 43 in his specific narrative), it is respectfully submitted that the Examiner is in error by stating that Ghoshal provides a boiling enhancement structure. The boiling enhancement structure of the Applicants' in-

vention is "a porous component that provides re-entrant cavities" (p. 10, lines 20-21). Neither Andres nor Ghoshal teach or suggest such a claim limitation. (Also see Declaration of Dr. Enchoa Yu, Appendix B to Amendment dated June 4, 2004, page 5, ¶ 18: "[N]either Ghoshal nor Osakabe teaches or suggests a porous component that provides re-entrant cavities.") Further, as amended, in response to the Examiner's comment, the claim includes in it the language from the specification defining the boiling enhancement structure as being a porous component that provides re-entrant cavities.

Ghoshal has "hot point" elements 250, which are disclosed as conically shaped (see col. 4, lines 9-15). Alternatively, they may be pyramidal, or any shape terminating at a tapered point (col. 4, lines 31-37), and are so required in order to function in accordance with Ghoshal's invention. *"Any configuration may be used as long as the hot points terminate at a tapered point"* (col. 4, lines 34-36; emphasis added; see also Ghoshal independent claims 1, 21, and 29, all requiring hot point elements). The Ghoshal hot point elements are structurally and functionally different from Applicants' boiling enhancement structure. As neither Andres nor Ghoshal have a boiling enhancement structure, the combined references do not include every element of Applicants' invention, and there is no *prima facie* case of obviousness.

Andres is a capillary-driven device, in that it is a heat pipe (col. 1, lines 29-44; col. 2, lines 63-68; see also the claims). Likewise, Ghoshal is a heat pipe and is capillary-driven (col. 1, lines 57-59; col. 2, lines 37-48; col. 2, line 62 through col. 3, line 2; col. 3, lines 34-37; col. 4, lines 37-45; see also the claims). The evaporation process of Andres and Ghoshal is a surface phenomenon and does not involve the formation of vapor bubbles that form in Applicants' invention. This is one reason why there needs to be only a thin layer of liquid, for example, in the

evaporator section of Ghoshal's device for it to function properly. Excess liquid at high heat fluxes would result in bubble formation that might block the capillaries and prevent the return of liquid from the condenser to the evaporator, known as the "boiling limit" in heat pipes, and needs to be avoided in Ghoshal. As both Andres and Ghoshal are capillary-driven, there can be no expectation of success in their combination to achieve a device that involves vapor bubble formation. In addition to the lack of a likelihood of success in modifying Andres in view of Ghoshal there is also no suggestion to modify or combine the teachings.

There being no *prima facie* case of obviousness, amended claims 1 and 43 are nonobvious with respect to Andres in view of Ghoshal.

With respect to claims 2, 3, 12, and 17-22, these claims depend either directly or indirectly from allowable claim 1, incorporating the limitations thereof, and are therefore allowable as well.

Claims 39 and 41 conclude with the clause "wherein thermosyphon performance is substantially independent of thermosyphon orientation." The Examiner cites Andres at column 1 lines 43-47 for such a disclosure. The Applicants respectfully submit that the cited text of Andres, where it is stated that "the present invention is independent of gravitational and inertial forces," is not equivalent to the condition recited in claims 39 and 41. Andres, rather, is directed to a near horizontal installation that is alleged to be helpful for motor vehicles, aircraft, or ships that must deal with inclinations, acceleration, and deceleration (column 1 lines 22-28). The Applicants' invention, however, operates over a much greater range of orientation – namely, performance is substantially independent of *any* orientation. As previously discussed, one example of this difference is when the devices are inverted (upside down). In that case, the Applicants'

invention (for example, Figure 8) operates substantially the same as it does when right-side-up (Figure 3) with the evaporator substantially full or full, but Andres' condensate collector (Figure 8) would be empty or near empty, with performance therefore significantly impaired. In addition, condensate could not drain upward into the evaporator. Performance results would likewise be similar in the case where the devices are vertically oriented, with the Applicants' invention (for example, Figures 6 and 7) performing similarly to when it is horizontal and Andres' performance impaired. Accordingly, Andres' performance is not disclosed or taught to be substantially independent of orientation. Nor can Ghoshal function at any other orientation than right-side-up and nearly horizontal (Figures 2 and 3). Therefore, claims 39 and 41 are nonobvious. Further, as amended, in response to the Examiner's comment the claim includes in it the language supported by the specification specifying the symmetrical geometry of the evaporator and condenser about a central plane, which none of the cited references include.

Claims 40, 42, and 44 each respectively depend from allowable independent claims 39, 41, and 43, and are therefore allowable.

With further respect to claims 17-22, 40, and 42, these claims all relate to coolant levels at various thermosyphon orientations. The performance of Andres is not substantially independent of orientation, and nowhere in Andres is it stated what the level of fluid in the heating channel is—Andres never teaches or suggests anything about having a substantially full or full evaporator at any orientation. Likewise, Ghoshal is not orientation independent. Ghoshal cannot be combined with Andres to result in a substantially full evaporator at any orientation. Coolant *cannot* fill the evaporator of Ghoshal. The liquid coolant, or transport fluid, of Ghoshal can only partially fill the Ghoshal evaporator, based on Ghoshal's operating principles. Ghoshal teaches

away from a substantially full evaporator by requiring that there be vapor in the evaporator region, which is transported by the vapor channels 235 (col. 4, lines 38-41).

Ghoshal would not function if the transport fluid substantially filled the evaporator region; if it did, not only would there be no void available for vapor in the evaporator, but the condenser region would also be substantially full of transport fluid. Ghoshal's Figure 2 does not show *any* fluid in between its first and second substrates 230, 240. Presumably, Ghoshal's evaporator does include some fluid. As discussed above, however, with respect to amended claims 1 and 43, the liquid coolant, or transport fluid, of Ghoshal only is present in the evaporator in a thin layer, and Ghoshal does not teach or suggest a substantially full evaporator in any orientation. Ghoshal would not function if the transport fluid filled the evaporator region; if it did, not only would there be no void available for vapor in the evaporator, but the condenser region would also be full of transport fluid. Ghoshal lacks the ability to have a full evaporator region, and accordingly would be rendered unsatisfactory for its intended purpose if its evaporator were full. There is no *prima facie* case of obviousness with respect to the combination of Andres and Ghoshal.

With further respect to claim 44, the Examiner has cited no reference that includes a step of providing a void in the evaporator to allow the coolant to directly contact the heat-dissipating element, and this claim should be allowed.

Claim Rejections – 35 USC § 103 – Andres in view of Anderson et al.

2. Claims 8-11, 18-22, 40, and 42.

The Examiner rejected claims 8-11, 18-22, 40, and 42 under 35 U.S.C. § 103(a) as obvious based on Andres in view of Anderson et al., US Patent No. 5,761,037 (Anderson). The Ex-

aminer specifically discusses only claims 8-11, which relate to a boiling enhancement structure; it is respectfully submitted that claims 18-22, 40, and 42 do not apply to boiling enhancement structures or to Anderson. Instead, these claims relate to levels of coolant in various orientations of a thermosyphon. For the reasons discussed above with respect to claims 17 through 22, 40, and 42, **claims 18-22, 40, and 42** are nonobvious and are allowable, as well as reasons set forth below.

First, **with respect to claim 8**, which is directed to a boiling enhancement structure including a plate with parallel grooves, Anderson's wicking manifold 102 is used to spread liquid in the evaporator, and is purportedly able to do this at any orientation. Applicants' boiling enhancement structure, however, is used mainly for trapping vapor to provide active nucleation sites for *boiling*, and is not used to ensure orientation-independent performance of the thermosyphon heat spreader. There is no suggestion in either Andres or Anderson to combine Anderson's structure for spreading liquid to make a site for vapor nucleation for boiling. Further, claims 8-11 depend either directly or indirectly from allowable claim 1, and respectively add limitations thereto, and are therefore allowable.

Next, **with further respect to claims 18-22, 40, and 42**, as stated above in the rebuttal of the rejection of claims 39 and 41, Andres is directed to a near horizontal installation that is alleged to be helpful for motor vehicles, aircraft, or ships that must deal with inclinations, acceleration, and deceleration (column 1 lines 22-28). The Applicants' invention operates over a greater range of orientation – namely, performance is substantially independent of *any* orientation. Coolant levels substantially or completely fill the Applicants' evaporator from when it is horizontal and right side up through vertically oriented (Figures 6, 7, 9-15, claims 18 and 19), all ori-

entations (claims 20 and 22), and right side up and upside down (claims 21, 40, and 42). Accordingly, Andres, or Andres in view of Anderson, does not disclose, teach, or include the characteristic of a substantially or completely full evaporator at any orientation. Further, these claims depend either directly or indirectly from allowable claims 1, 39, or 41, incorporating the limitations thereof, and are therefore allowable as well.

Claim Rejections – 35 USC § 103 – Andres in view of Paal

3. Claim 14.

Claim 14 is directed to a second evaporator plate formed with at least a part of the heat-dissipating component from a single piece of material. The Examiner rejected claim 14 as obvious under 35 U.S.C. § 103(a) based on Andres in view of Paal, US Patent No. 5,051,814 (Paal). Claim 14 is allowable as it depends from allowable claim 12, which depends from allowable claim 1, and adds limitations thereto.

Allowable Subject Matter

The Applicants appreciate the Examiner's acknowledgement of claims 23-32 and 36-38 as being allowable if rewritten in independent form including all of the limitations of the base claim, including claim 1 as previously presented, and any intervening claims. Claim 23 has been rewritten to satisfy such requirements for all of claims 23-32 and 36-38.

If the Examiner has any questions about the present Reply, a telephone interview is respectfully requested.

As the rejections entered by the Examiner in the Official Action dated September 7, 2005 have been shown to be inapplicable, reconsideration and allowance of claims 1-3, 8-12, 14, 17-22, 33-35, and 39-44, and passage of these claims to issue, is hereby respectfully requested. Further, as the Examiner previously agreed that allowable claim 1 is generic with respect to claims 1-42 and allowable claim 39 is generic with respect to claims 40-42, it is requested that the withdrawn claims be reconsidered and all claims passed to issue.

Respectfully submitted,

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